

<b>Devi Ahilya University, Indore, India Institute of Engineering &amp; Technology</b>				<b>III Year B.E. (Electronics and Telecommunication)</b>			
<b>Subject Code &amp; Name</b>	<b>Instructions Hours per Week</b>			<b>Credits</b>			
<b>ETR5C2 DIGITAL COMMUNICATION</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Total</b>
<b>Duration of Theory Paper: 3 Hours</b>	<b>3</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>1</b>	<b>1</b>	<b>5</b>

### **Learning Objectives:**

The course contents are aimed to provide:

- (1) Knowledge of various digital encoding techniques.
- (2) Understanding of various baseband and bandpass transmission and reception techniques.
- (3) Acquaintance with source encoding and channel encoding techniques.
- (4) To know why digital communication systems are better than analog communication systems.

### **Prerequisites:**

Knowledge of Fourier analysis and random variables.

## **COURSE CONTENTS**

### **UNIT-I**

Review of Fourier transforms, Energy Spectral Density, Power Spectral Density and their properties, sampling & its types, TDM. Digital encoding techniques: PCM, quantization (uniform and non-uniform), quantization noise, DPCM, ADPCM, DM, ADM and their comparison.

### **UNIT-II**

Line coding techniques: Desirable characteristics of Line codes, NRZ and RZ forms of unipolar, polar & bipolar and bi-phase line codes and their waveforms, PSDs and comparison. Inter Symbol Interference, pulse shaping (Raised cosine spectrum, duo-binary signalling), Eye patterns. Baseband reception and probability of error, optimum filter, matched filter, correlation receivers.

### **UNIT-III**

Band-pass modulation and demodulation techniques: BPSK, DPSK, QPSK, BFSK, M-ary PSK & FSK, MSK (their generation, detection, waveforms, PSDs, signal constellation diagrams, performance of these systems in the presence of noise). Introduction to Spread Spectrum techniques.

## **UNIT-IV**

**Information theory:** Concept of amount of information, entropy & its types, source encoding such as Shannon-Fano, Huffman Codes. Information rate, channel capacity (its calculation for Binary Symmetric channel, Binary Erasure Channel, noiseless channels and Gaussian channel), Shannon's theorem, bandwidth and S/N trade off .

## **UNIT-V**

**Channel encoding techniques:** Linear Block codes (Systematic Linear Block codes, Parity check matrix, Syndrome testing), cyclic codes, Hamming codes, BCH codes, convolution codes, their encoding and decoding operation.

## **Learning Outcomes:**

Upon Completing the Course, Student will able to learn:

- (1) Various processes and their types involved in digital communication system.
- (2) Application and selection of these processes with their types, according to requirement.

## **BOOKS RECOMMENDED:**

- [1]. Lathi B. P., Modern Analog and Digital Communication Systems, 4<sup>th</sup> ed., Oxford Univ. Press, 2011.
- [2]. Haykin Simon Communication System, 4th ed., Wiley Publication, 2001.
- [3]. Schaum's Outline Series, Analog and Digital Communication, 2nd ed., TMH, 2006.
- [4]. Taub & Schilling, Principles of Communication System, 4<sup>th</sup> ed., TMH, 2013.
- [5]. Dr. Bernard Sklar, Digital Communication, 4th ed., Pearson education, 2001.
- [6]. Proakis & Salehi, Digital Communication, 2nd ed., McGraw Hill, 2004.

## **List of Practical Assignments:**

### **Assignment I**

Fourier synthesis of various waveforms.

- (a) To perform Fourier synthesis of square wave.
- (b) To perform Fourier synthesis of triangular wave.
- (c) To perform Fourier synthesis of AM with suppressed carrier wave.
- (d) To perform Fourier synthesis of AM with carrier wave.
- (e) To perform Fourier synthesis of DTMF signals.

### **Assignment II**

Performance evaluation of digital communication system in presence of various line encoding techniques .

- (a) To generate various line encoding techniques like unipolar, polar, bipolar with RZ and NRZ format.
- (b) To draw the PSD of these line encoding techniques.

- (c) To compare the performance of these line encoding techniques.

**Assignment III**

Performance evaluation of digital communication system in presence of various digital modulation techniques .

- (a) To evaluate the performance of MPSK for  $M=2,4,8,16$  and their comparison study.
- (b) To evaluate the performance of ASK.
- (c) To evaluate the performance of MFSK for  $M=2,4,8,16$  and comparison study.
- (d) How will select a particular modulation technique for a particular application

**Assignment IV**

Performance evaluation of digital communication system in presence of various error correcting codes .

- (a) To evaluate the performance of Hamming code.
- (b) To evaluate the performance of Convolution code.
- (c) Performance comparison of these two codes.
- (d) How will select a particular channel code for a particular application.

**Assignment V**

Performance evaluation of digital communication system in presence of various communication channels .

- (a) To evaluate the performance of AWGN channel.
- (b) To evaluate the performance of fading channel.
- (c) Performance comparison of different communication channels.
- (d) What will be the impact of a communication channel on the performance of digital communication system.